

## RECOMMENDATIONS FOR PROPOSED ACTIVITIES IN THE OZARK HIGHLANDS

The proposed project is located within the Ozark Highlands Ecoregion (Omernik, 1987). This is a region of karst terrain. Karst describes a type of topography that has developed as a result of the dissolution of soluble bedrock over time. Water becomes slightly acidic as it takes up carbon dioxide while passing through surface soils. The dissolving action of this acidic water on subsurface soluble rocks produces today's karst features.

Karst processes in the Ozarks Highlands Ecoregion have produced a landscape characterized by eroded rolling hills, bluffs, and dry valleys. Karst features include highly unique and sensitive habitats such as caves, sinkholes, losing streams (*i.e.*, streams that lose significant quantities of surface water flow into the groundwater system), springs, and complex underground drainage systems. Highly specialized and often rare fish and wildlife species, including species of bat, salamander, cavefish, and crayfish, spend all or a part of their lives in these unique and sensitive karst habitats. Several of these species are afforded protection under the Endangered Species Act and similar state regulations.

Karst environments are highly vulnerable to groundwater pollution. Water enters the groundwater systems rapidly as it passes through sinkholes and cracks and crevices in the ground surface, such as fractures in stream beds (*i.e.*, losing streams), or fractured limestone under thin layers of permeable soils. Groundwater in karst areas can travel as quickly as a few thousand feet to over a mile per day. Degradation of sensitive, underground habitats and the associated groundwater can, therefore, occur rapidly in areas of karst topography. These and other characteristics of karst ecosystems make the underground environment relatively fragile and highly susceptible to disturbances.

The Ozark region is one of the fastest growing regions of the country due to relatively inexpensive land prices and the aesthetics of the area. As human growth and development in the region increases, threats to unique and valuable fish and wildlife resources also increase. Careful project planning is imperative to reduce unnecessary impacts to the high quality fish and wildlife resources found in the Ozark Highlands. Implementation of Best Management Practices (BMPs), such as sediment and erosion control measures, during the construction phase of projects often ensures that environmental impacts are avoided or minimized.

### List of BMPs for Proposed Activities in Karst Areas

- Implement a sediment and erosion control plan using best management practices during construction such as a) the installation of sediment fencing and straw hay bales to capture sediment, and b) stock piling any excavated material well away from streams and other karst features such as a cave opening so that the material cannot slough back into these areas (see also [www.deq.state.ok.us/ECLSNEW/sitestrn.htm](http://www.deq.state.ok.us/ECLSNEW/sitestrn.htm)).
- Monitor sediment/erosion control measures after precipitation events. Clean, repair, and replace structures as necessary.
- Monitor sediment/erosion control measures periodically throughout all phases of construction. Clean, repair, and replace structures as necessary.
- Establish staging areas for the crew, equipment, hazardous materials, chemicals, fuels, lubricating oils, etc., no closer than 300 feet of a stream bank, sinkhole, spring, or cave entrance.

- Install sediment and erosion controls around staging areas to prevent discharge from these sites.
- Store construction waste materials, debris, and excess materials well away from karst features.
- Refuel construction equipment at least 100 feet from stream banks, sinkholes, springs, and cave entrances.
- Use the horizontal directional drilling method for proposed pipeline crossings of streams and wetlands, especially those streams which contain flowing water during project implementation to avoid impacts to these resources.
  - Prior to implementing a directional drill, a geotechnical investigation using the least intrusive means possible (e.g., ground penetrating radar, minimal exploratory bore hole drilling, seismic refraction and reflection, etc.) should be done to determine subsurface/geologic conditions that would be encountered along the drill path to ensure that a directional drill pipeline at the location would be feasible and not result in unnecessary damage to a sensitive area such as a karst void.
  - If the directional drilling method would not be feasible, we recommend that you:
    - conduct stream crossings during a period of low stream flow (July to October)
    - limit tree trimming and cutting to only what it is necessary
    - limit access of construction equipment within the stream channel to one confined location, preferably over an existing bridge, equipment pads, clean temporary native rock fill, or over a temporary portable bridge
    - limit in-stream equipment to that needed to construct a crossing
    - do not alter or remove natural stream features such as riffles or pools
    - place trench spoil at least 10 feet away from stream banks
    - use sediment filter devices to prevent flow of spoil off the right-of-way
    - de-water the trench, as necessary, to prevent discharge of silt laden water into stream during construction and backfilling operations
    - return the substrate and contours of the bank and bottom of the channel to pre-project conditions.
- Maintain natural stream features such as riffles or pools.
- Keep all machinery out of streams as much as possible.
- Limit the removal of riparian vegetation to only when it is necessary.
- Replace any woody riparian vegetation unavoidably lost by planting five trees for every tree lost. Only native riparian plants should be used to help prevent the spread of exotics.
- Contact the Service if karst features, such as sinkholes, springs, and cave openings, are discovered on the project site during any aspect of project implementation for further evaluation to determine if the feature is used by federally-listed species.
- Leave a wide natural vegetated buffer area around any sinkholes, springs, and cave openings (minimum of 300 feet), and along any streams (minimum 100 feet) located on the project site.
- Re-vegetate all disturbed areas as soon as possible after construction using only native plants to reduce soil erosion. Annual species, such as rye or wheat, may initially be planted along with native species in areas subject to immediate soil loss, such as a steep slope, to provide rapid erosion control. Final re-vegetation should use native species only.
- Plant a vegetative buffer of at least 100 feet around any sinkholes on the property if the vegetation was previously cleared.

- Apply fertilizers, herbicides, pesticides, or other chemicals no closer than 100 feet of sinkholes, losing streams, springs, and cave openings.
- Locate waste lagoons, storm water basins, feed lots, or septic systems away from sinkholes, springs, and caves.
- Remove and dispose of all debris and excess construction materials properly upon project completion.
- Evaluate the establishment of vegetation after project completion and inspect all sediment control structures at one month intervals for at least 3 months. Retain sediment control structures until site stabilization is achieved; and
- Remove temporary sediment/erosion control structures upon final site stabilization.

## **Identifying Undiscovered Karst Features**

The measures most important to conserve listed cave species include 1) obtaining and utilizing knowledge of the cave locations used by the species, 2) limiting human disturbance to occupied caves, and 3) protecting known caves and surrounding foraging areas from habitat loss due to development. Essential information, such as the location of caves used by listed species, is often incomplete, and the extent of karst features in the vicinity of the proposed project may be larger than what is currently known. Undiscovered karst features, such as a cave opening and underground passages, may occur on or near project sites, even in previously developed areas. The Service recommends the following precautionary measures be taken to avoid impacts to federally-listed and sensitive karst species:

1. Survey the project right-of-way for karst features such as cave openings and sinkholes.
2. Establish a buffer area of about 300 feet around any caves or sinkholes found during the survey (or during any aspect of project implementation). The Service should be contacted for further evaluation to determine if the cave is used by federally-listed or sensitive cave species.
3. If a cave is used by federally-listed or sensitive species, we will likely require the cave to be mapped when bats are not present to determine if any additional openings or passages may be affected by the project. In addition, we may recommend modifications of the proposed project to allow additional buffer areas to be established. Incorporation of additional buffer areas may be necessary to avoid impacts to federally-listed or sensitive species.
4. In the event that holes or other openings are encountered during construction activities, no fill materials should be placed into the opening until Service or Service approved personnel have the opportunity to investigate the site thoroughly.

## **References**

Omernik, J.M. 1987. Ecoregions of the conterminous United States. Map (scale 1:7,500,000) revised August 2002. *Annals of the Association of American Geographers* 77:(1) 118-125.